Amendments to the Drawing:

The drawing has been amended to show uniformly thick and well defined lines, numbers, and letters.

REMARKS/ARGUMENTS

Claims 4 and 6 are pending in the present application. Claim 5 has been canceled by this amendment without prejudice or disclaimer.

Claims 1, 2, and 3 were previously canceled.

Initially, Applicants point out that the amendments to claims are made only to address the Examiner's rejection under 35 USC § 103(a) in the interest of forwarding prosecution. In particular, claim 4 has been amended to incorporate the features of former 5.

Claim Rejections under and 35 USC § 103(a)

Claims 4 and 6 stand rejected under 35 USC § 103(a) as unpatentable over Abe et al. (EP Application No. 1 365 142, hereinafter Abe) in view of Olav et al. (DE Patent No. 100 45 281, hereinafter Olav), and claim 5 stands rejected under 35 USC § 103(a) as unpatentable over Olav. Applicants traverse these rejections.

Discussion of Disclosed Embodiments

The following descriptive details are based on the specification. They are provided only for the convenience of the Examiner as part of the discussion presented herein, and are not intended to argue limitations which are unclaimed.

Referring to the single figure, an injection pump of a common rail injection system according to Applicants' disclosed embodiments is provided with a piston 2 and a pump cylinder 3 guided in a cylinder housing 1 (see paragraph [0019] of the published version of the present application (US 2008/0247891). A camshaft 4 driven by an engine moves the piston 2 into the pump cylinder 3 and, thereupon, a piston spring 5 moves the piston 2 in the reverse direction (see

paragraph [0019]). The cylinder housing 1 also contains two nonreturn valves 8, 10, one allowing liquid to flow into the pump cylinder 3 and the other one allowing liquid to flow out of the pump cylinder 3 (see paragraph [0022] - [0023]). The movement of the piston 2 results in a recurrent extension and retraction of an operating space 6 of the pump cylinder 3 leading to a pump action conveying fuel into the common rail. On the head region of the piston 2 a truncated centering cone 20 is formed. The centering cone 20 extends from a region of the piston having a large diameter D to the end of the piston 2 in the operating space where it has its smaller diameter d, the diameters of the cone being selected such that the ratio of (1/2 x [D - d]) to the larger diameter D equals approximately 1:200 and the ratio of the height l of the cone to the piston skirt length L approximately equals 1:6.6 (see paragraph [0026]). A bevel with a further truncated centering cone 30 is formed on the centering cone 20, the axis of the further centering cone 30 deviating from the axis of the centering cone 20 by not more than 1μm (see paragraph [0027]). As explained in paragraphs [0015] and [0028] of the published application, the above-mentioned parameters of the centering cone 30 and further centering cone 30 prevent one sided contact the piston by causing the build up of pressure between the pump piston 2 and pump cylinder 3.

As will be easily understood, the centering effect of the inventive cone is based on the pressure of fluid flowing into the gap between the centering cone and the cylinder wall. For a centering effect, the pressure has to create a force in a direction perpendicular to the direction of movement of the piston 2. To this end, an area portion of the cone perpendicular to the force has to be sufficiently large to make the piston float in the cylinder while moving. Hence, if the area perpendicular to the force is dimensioned too small, the resulting force will not suffice to take the piston off the cylinder wall, such that a centering effect will not be noticeable. Also, if the centering

cone 20 and the further centering cone 30 deviate by more than the given value in their axes, their effects interfere and decrease one another.

Arguments

The art cited by the Examiner fails to disclose, teach or suggest that "a piston/cylinder unit for a high pressure pump, comprising a housing defining a pump cylinder, a piston arranged in said pump cylinder and having a first end defining a head region of said piston and a second end opposing said first end ..., wherein said piston comprises a *first centering cone* at said head region comprising a truncated cone having a circular base area and a top area, wherein a ratio of a maximum half diameter reduction of said first centering cone with respect to the diameter of said piston is approximately 1:200 and a ratio of the axial length of said first centering cone to the length of said piston is approximately 1:6.6 and a bevel comprising *a second centering cone* positioned on said first centering cone, wherein a *distance between a center axis of said first centering cone and a center axis of said second centering cone has a maximum tolerance of 1μm*", as recited by Applicants' claim 4.

At page 3 of the Office Action, the Examiner asserts that Abe's chamfered end may be considered a centering truncated cone as claimed in claim 4. More specifically, the Examiner states that the numerical ratio values are not patentable unless there is evidence that the ratio is critical.

Abe describes in Fig. 1 and paragraph [0013] a high pressure fuel pump 1 for a common rail system. The fuel pump 1 comprises an intake passage 10 comprising an intake valve 5, a pump chamber 12 and a discharge passage 11 with a discharge valve 6, with the valves working in principal as check valves. To operate the pump 1 a plunger 2 is moved in and out of the pump

chamber 12. According to Fig. 1, the plunger 2 is chamfered at the end extending into the pump chamber 12.

As stated above, the claimed ratio values produce a centering affect during the compression stroke. However, the chamfered end of Abe will <u>not</u> have the centering effect. In particular, the chamfering shown in Abe with an angle of approximately 45° and a short axial extension is unsuitable to provide a side force as described above. It does not have the sufficient lateral surface area portion to transform pressure into a transverse force and, hence, cannot make the piston take off and float while moving. Therefore, the chamfered end may not be considered a centering cone.

Olav fails to teach or suggest what Abe lacks. Olav also discloses a high pressure pump 1 with intake passages 5, a cylinder chamber 4 for compression and a connection 12 for discharge in Fig. 1 and paragraph [0014]. A plunger 6 is arranged to compress the content of the cylinder 4 upon operation of a camshaft. As disclosed, for example, in paragraph [0018] the plunger 6 has a slightly beveled circumferential surface in its head region 7 of about 1 minute of angle. The length of the beveled surface is approximately equal to the range of the stroke of the plunger 6. The beveled surface shall compensate for heat insertion to the cylinder decreasing with the distance to the flange facing 10 of the plunger 6, and for compression of the plunger 6. As described in Olav, the beveled surface also has a centering effect on the plunger 6, see paragraph [0019]. In Fig. 1 the flange facing is shown with an annular step. The step is spaced apart from the edge between the beveled surface and the flange facing 10.

On page 5 of the Office Action the Examiner assumes that the step shown in Olav could just as well be beveled and manufactured with a low deviation from the axis of the plunger 6, and thus could be a centering cone as presently claimed. However, even assuming, *arguendo*, that a skilled

person could be motivated to design the step with a beveling, the step feature would not have any supporting effect on the centering of the piston.

In the present application, the further centering truncated cone 30 acts as a guide member for the piston 2 and derives this characteristic from the fluid flowing along the cone surface into the gap. It also supports a buildup of pressure in the gap further supporting a centering effect.

Beveled or not, the step feature shown on the flange facing 10 of Olav is inappropriate to achieve either of the described actions. Due to the step, there is a flat rim encircling the flange facing 10 that is oriented in the direction of movement of the plunger 6. The flat rim impedes most of the flow of fluid along the step to the gap at the beveled surface of the plunger 6, such that it can neither serve as a guide member for the plunger 6 nor support buildup of pressure. Thus, the step feature does not have a considerable centering effect.

As a result, neither the chamfered end disclosed in Abe nor the step disclosed in Olav can disclose, teach or suggest a configuration having an additional centering effect of a further truncated cone additionally disposed on a beveled head region of a piston in order to support a centering effect of the piston. Also, the centering effect of such cone could not have been foreseen in view of Abe and Olav. In addition, it remains unlikely that any additional features on a head region are manufactured with such a high precision as claimed in claim 4. Not suggesting a further centering truncated cone, none of the documents can provide a motivation for such a precise production.

Accordingly, claim 4 is deemed to be patentably distinct over the cited art for at least the above foregoing reasons. Claim 6, which depends on claim 4, is deemed to be patentably distinct over the cited prior art for at least the same reasons discussed above with respect to claim 4.

In view of the above, Applicants request that the rejections under 35 USC § 103(a) be withdrawn.

CONCLUSION

This application is now believed to be in condition for allowance, and early notice to that effect is solicited.

It is believed that no fees or charges are required at this time in connection with the present application. However, if any fees or charges are required at this time, they may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,
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